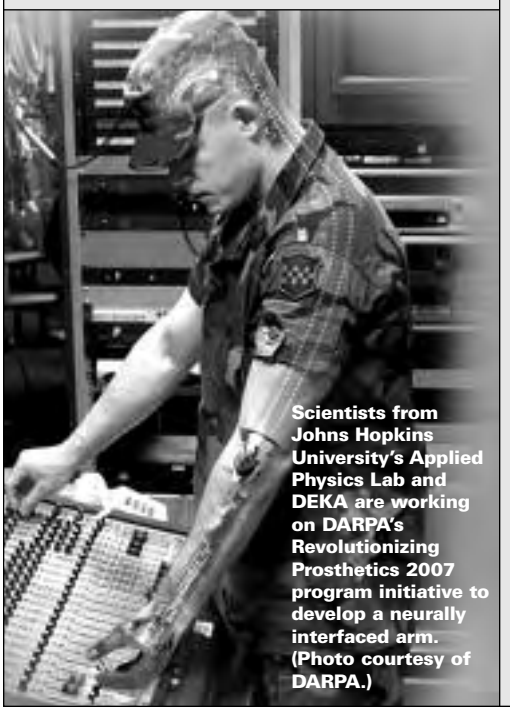
DARPA Revolutionizes Prosthetics

Throughout history, the battlefield loss of limbs has driven technological progress in the prosthetics field. As of August 2006, there are more than 460 amputees as a result of combat operations in Iraq and Afghanistan who underscore the urgent need to accelerate progress in this field. The Defense Advanced Research Projects Agency (DARPA) is bringing together advances across disparate scientific disciplines with its Revolutionizing Prosthetics initiative.

"DARPA has undertaken the monumental task of fulfilling its pact to our Soldiers by embarking on an effort to provide fully integrated limb replacements that enable victims of upper body limb loss to perform arm and hand tasks with the strength and dexterity of the natural limb," explained COL Geoffrey Ling, M.D., Ph.D., Revolutionizing Prosthetics Program Manager. "In four years, we anticipate having a prosthetic arm that will be neurally controlled identically to the way that we control our biological arms."

While the DARPA initiative focuses on upper-extremity prosthetics as the most challenging technical problem, it is expected that the technologies developed will be readily adaptable to lower-extremity amputees as well. There are two separate programs that fall under DARPA's Revolutionizing Prosthetics initiative, Revolutionizing Prosthetics 2009 and Revolutionizing Prosthetics 2007. Each program has a lead contractor and includes a large team of researchers.



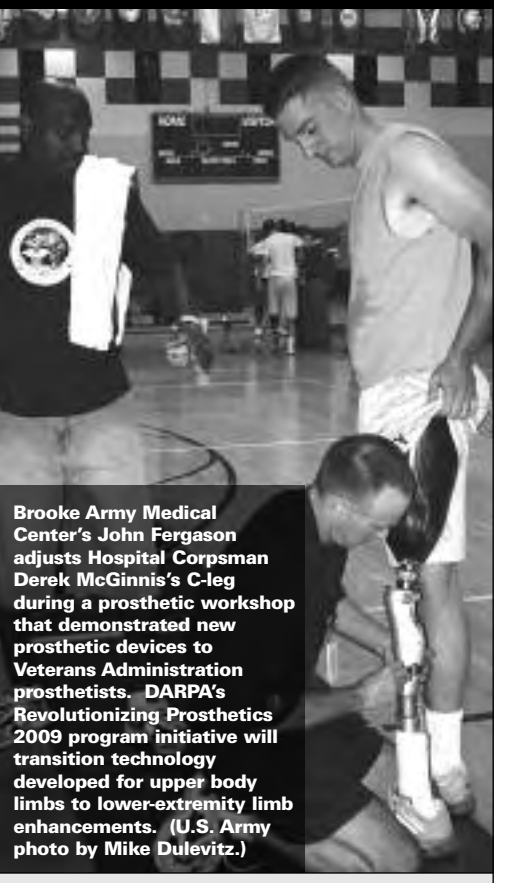
Scientists from Johns Hopkins University's Applied Physics Lab and DEKA are working on DARPA's Revolutionizing Prosthetics 2007 program initiative to develop a neurally interfaced arm. (Photo courtesy of DARPA.)

The Army Research Office, Research Triangle Park, NC, is contracting and coordinating the Revolutionizing Prosthetics 2007 program. Several other projects are feeding into the effort as it matures. Among these are research projects exploring alternative methods of signal extraction from the nervous system, new materials that can redefine the concept of biocompatibility to include functional as well as structural integration and ways to regenerate neural pathways to control and sense the prosthetic directly.

At the end of the 2-year Revolutionizing Prosthetics 2007 program, a prosthetic arm system will be ready for human clinical trials. This program will leverage recent research advances to develop a prosthesis that will dramatically improve the capability of upper-extremity prosthetic limbs beyond those that are available commercially. It will incorporate the best possible technologies and the most revolutionary short-term developments into a highly advanced, neurally interfaced prosthetic arm. The focus will be on providing near-human strength in a prosthetic limb, and creating a prosthetic arm that is both functional and similar in appearance to the native limb. The new prosthesis will have increased range of motion, strength, endurance and dexterity, and it will significantly improve an arm amputee's ability to perform daily living activities.

The longer-range Revolutionizing Prosthetics 2009 program seeks to create a neurally controlled artificial limb that will restore full motor and sensory capability to upper-extremity amputee patients. This revolutionary prosthesis will feel, look and perform like the native limb. At the end of the 4-year program, the resulting prosthesis will be ready for human clinical trials. Key to this is a prosthetic that has:

- Sensors for touch, temperature, vibration and proprioception — the ability to sense the position of the arm and hand relative to other parts of the body.
- A power source that will allow at least 24 hours of normal use.



Brooke Army Medical Center's John Fergason adjusts Hospital Corpsman Derek McGinnis's C-leg during a prosthetic workshop that demonstrated new prosthetic devices to Veterans Administration prosthetists. DARPA's Revolutionizing Prosthetics 2009 program initiative will transition technology developed for upper body limbs to lower-extremity limb enhancements. (U.S. Army photo by Mike Dulevitz.)

- Mechanical components that will provide strength and environmental tolerance of heat, cold, water, humidity and dust, among others.
- Durability such that the device will last at least 10 years with normal use.

In short, with this revolutionary mechanical arm, an upper-extremity amputee would be able to feel and manipulate objects as a person would with a native hand. Ideally, the device would grant an amputee the fine motor control necessary to thread a needle, use a computer keyboard, play a piano or perform fretwork on a guitar. Amputee service men and women could return to activities of their choice either within the services or civilian society.

"We will do whatever is necessary to restore these people who have given up so much for the idea of freedom and in service to their country," Ling concluded. "Taken together, these two programs will advance the state-of-the-art in prosthetics while delivering an advanced upper-extremity prosthetic device in two years."

Editor's Note: For a related story on prosthetics, go to Page 78.